3.1 SURFACE WATER

This section is based largely on the findings of the project surface water analysis conducted by Associated Earth Sciences, Inc. (AESI 1998).

3.1.1. Affected Environment

The entire project site lies within the 171-square-mile Chambers-Clover Creek watershed. The Sequalitchew Creek drainage is a sub-basin within this watershed, which contains the site. Sequalitchew Creek originates in 81-acre Sequalitchew Lake offsite to the east. The creek flows through Hamer Marsh and Edmond Marsh before following a course down a steep ravine along the site's north and northeastern boundary into Puget Sound north of the Nisqually River delta mudflats. The upper and lower reaches of the creek flow intermittently during the dry season (DuPont Environmental Remediation Services and Hart Crowser, 1994c). When there is little or no flow in the lower reach, salt water backs up into the channel from Puget Sound.

There are four glacial kettles (a steep-sided glacial depression without surface drainage) in Parcel 1, one of which contains water either intermittently or year-round. This kettle (Old Fort Lake) is located in the southern half of the project site. Old Fort Lake lacks inflow or outflow streams and is controlled by groundwater elevations (DuPont Environmental Remediation Services and Hart Crowser, 1994c). Two small kettles in the north-central portion of the site are depicted on the U.S. Geological Survey (USGS) Nisqually quadrangle topographic map. A fourth kettle is located in the northernmost corner of Parcel 1. The three kettles other than Old Fort Lake have not held any appreciable water for at least the last 8 years, if ever.

Puget Sound and the Nisqually mudflats are located along the base of an adjacent steep slope parallel to the northwestern and western boundaries of Parcel 1. This boundary follows the uppermost contour of the slope approximately 175 feet above mean sea level. It also coincides with a catch line of a west-facing onsite slope that has a grade approaching 30 percent.

Steilacoom Gravels comprise the surficial soils at the project site. The thickness of these deposits ranges from 20 to 40 feet over much of the eastern and central portions of the project site. The Steilacoom Gravels consist of stratified sands and gravels with cobbles and occasional zones of siltier sand. The coarse grain size of the Steilacoom Gravels allows for rapid infiltration of surface water and little to no runoff.

Soil horizons developed on top of the Steilacoom Gravels consist of gravelly, sandy loam with variable percentages of organic matter and volcanic ash. These soil horizons range in thickness from a few inches to approximately 3 feet, depending on topography and vegetation.

Sequalitchew Creek Water Quality

As part of the former DuPont Works site remedial investigations (RI) conducted by DuPont Environmental Remediation Services and Hart Crowser (1994b), four surface water quality sampling stations were established in Sequalitchew Creek (surface water Station 1 [SW-1]) [downstream] through SW-4 [upstream]). The stations were sampled several times between 1986 and 1989 and quarterly during 1992 (March, June, September, and December). During the RI, DuPont Environmental Remediation Services and Hart Crowser monitored nitrate-nitrogen, total petroleum hydrocarbons (TPH), 14 metals (total and dissolved), polycyclic aromatic hydrocarbons (PAHs), nitroaromatic explosives (NAX), nitroglycerin (NG), monomethylamine (MMAN), polychlorinated biphenyls (PCBs), total organic carbon (TOC), total dissolved solids (TDS), pesticides, and total suspended solids (TSS). During quarterly sampling in 1992, semivolatile organic compounds (SVOCs) were analyzed. During the initial sampling efforts in 1988, volatile organic compounds (VOCs) were measured.

PCBs, NAX, TPH, SVOCs, and NG were undetectable in Sequalitchew Creek. (Undetectable is defined as no analytical result that is above the detection limit for the specific analytical test). PAHs were detected at SW-1, located near the creek's mouth. Water temperatures at all surface water stations met the State Class A criterion of 18° C. One dissolved oxygen measurement was below the State Class A criterion of 8.0 milligrams per liter (mg/L) at the uppermost station (SW-4), which was attributed to natural causes in the headwater wetlands. Seven pH measurements were below the Class A lower criteria limit of 6.5, with at least one exceedance recorded at each sampling station.

Total copper and lead data were detected in Sequalitchew Creek. Two of 15 samples exceeded the acute standard at SW-1 on December 8, 1992. The surface water acute standard for total copper is 0.0081 mg/L for a hardness of 51 mg/L of $CaCO_3$ (WAC 173-201A-040). The measured values exceeding this standard for copper were 0.014 mg/L and 0.0096 mg/L total copper (DuPont Environmental Remediation Services and Hart Crowser, 1994b). The chronic total copper standard at the same hardness is 0.0057 mg/L total copper, which was exceeded for 7 of the 15 observations and at all four stations. Sources for the copper and lead measured in these samples were not known, although offsite sources were suspected for at least the dissolved fraction of these metals in the samples. All total and dissolved samples for zinc met the acute and chronic state surface water criteria of 0.059 mg/L and 0.053 mg/L, respectively.

Total lead detection limits were higher than the chronic lead standard of 0.0009 mg/L. Two values exceeded detection limits, with both values (0.039 mg/L and 0.02 mg/L) exceeding the acute standard for lead (0.008 mg/L). Both of these samples (including one duplicate sample) were collected December 8, 1992, at SW-1. Ecology's practical quantitation limit (PQL) standard for dissolved lead is 0.003 mg/L, which is equal to the detection limit used during all analyses, except for one analysis at SW-1 on December 8, 1992, which had a 0.015 mg/L detection limit (DuPont Environmental Remediation Services and Hart Crowser, 1994b). During monitoring, two samples exceeded the PQL established for lead: one sample was collected at SW-1 on March 13, 1992, and the other was collected at Station SW-4 on March 13, 1992. Total and dissolved chromium and cadmium were not detected during RI sampling (DuPont Environmental Remediation Services and Hart Crowser, 1994b).

Backwater tidal effects in lower Sequalitchew Creek are evident during low-flow periods, where TDS concentrations have been measured as high as 28,000 mg/L (DuPont Environmental Remediation Services and Hart Crowser, 1994b).

Old Fort Lake Water Quality

Old Fort Lake is a small kettle lake hydrologically supported by groundwater, with no surface inflows or outflows. Water level elevations in the lake reflect aquifer water levels. Seasonal water level data collected by DuPont Environmental Remediation Services and Hart Crowser (1994b) showed 8 feet of lake-water level fluctuation.

Three surface water quality sampling stations (identified as SW-5, SW-6, and SW-7) were established as part of the RI studies conducted for the former DuPont Works site. Water quality data were collected annually in 1986, 1988, and 1989 and quarterly during 1992 (March, June, September, and December) by DuPont Environmental Remediation Services and Hart Crowser (1994b). Surface water quality parameters collected include nitrate-nitrogen, TPH, 14 metals (total and dissolved), PAHs, NAX, NG, MMAN, TOC, TDS, and TSS (DuPont Environmental Remediation Services and Hart Crowser, 1994b). VOCs were analyzed during the initial sampling (DuPont Environmental Remediation Services and Hart Crowser, 1994b).

NAX, TPH, VOCs, MMAN, and NG were undetectable in Old Fort Lake samples. However, phenanthrene was detected at all three lake surface water stations. Lake waters were mostly neutral in pH, well oxygenated with low nitrate + nitrite concentrations (DuPont Environmental Remediation Services and Hart Crowser, 1994b). During the summer, lake temperatures exceeded 18° C at all stations. Lake pH ranged from 6.3 (SW-7 on March 13, 1992) to 8.8 (SW-5 on June 25, 1992), slightly beyond the pH range of 6.5 to 8.5 established by State Class AA standards.

Similar to Sequalitchew Creek, Old Fort Lake waters have total copper and lead concentrations exceeding the Class A standard for the protection of aquatic biota. Total copper concentrations exceeded the state surface water chronic criterion for copper during all samplings at all stations (0.0047 mg/L at a hardness of 40 mg/L of $CaCO_3$) (Chapter 173-201A WAC). Total copper exceeded the acute standard of 0.0064 mg/L during three sampling events between March and December 1992. Lead detection limits were higher than the chronic lead standard of 0.0007 mg/L for a hardness of 40 mg/L of $CaCO_3$, and 5 of the 22 observations were greater than the detection limit and the chronic standard. No exceedances of the acute lead standard were measured. However, three samples exceeded Ecology's PQL standard for dissolved lead (0.003 mg/L, which was also the RI dissolved lead detection limit). These samples were collected at SW-6 (June 29, 1988) and SW-7 (March 13, 1992).

Southern Puget Sound Water Quality

As a part of Ecology's Puget Sound Water Quality Monitoring Program, ambient water quality data were collected eight times near the mouth of the Nisqually River (Station No. NSQ002) from October 1984 through September 1985. Water samples were collected at a depth of 0, 10, and 30 meters. State Class AA (extraordinary) marine water quality standards are applicable to samples collected at this station (Chapter 173-201A WAC).

Ambient water sampling revealed waters of good quality that were low in nitrite-nitrogen, nitrate-nitrogen, and ortho-phosphate concentrations. Six of the 23 total temperature readings exceeded the marine Class AA criterion of 13.0° C at depths varying from 0 to 10 meters. Dissolved oxygen concentrations met the Class AA standard of greater than 7.0 mg/L, with an average concentration of 8.7 mg/L (range of 7.2 to 8.1 mg/L). The average pH was slightly basic (7.9 pH units). All pH readings were within the Class AA marine criteria range of 7.0 to 8.5 pH units. Waters were clear, with an average turbidity of 1.2 NTU. Fecal coliform counts were low and met the Class AA marine criterion of 14 colonies/100 mls (standard applies to a geometric mean) during each sampling event.

Ambient water quality samples were collected monthly at the Dana Passage Station (No DNA001) by Ecology from November 1989 through September 1996. Water quality samples were collected at three depths (0, 10, and 30 meters) during each sampling. State Class AA marine water quality standards are applicable to samples collected at this station (Chapter 173-201A WAC).

During monitoring, water quality was mostly good, with the exception of elevated temperatures and low dissolved oxygen concentrations. During this period, 77 temperature readings of the 242 total exceeded the Class AA marine criterion of 13.0° C. The average dissolved oxygen concentration was 8.6 mg/L and ranged from 3.5 mg/L to 15.4 mg/L. Seventeen of 241 dissolved oxygen readings were below the Class AA criterion of 7.0 mg/L. The average pH was slightly basic at 7.9 pH units, with two pH readings outside of the marine Class AA criteria range of 7.0 to 8.5 mg/L. At the time of sampling, marine waters had low ammonia, nitrate- and nitrite-nitrogen, and ortho-phosphate concentrations. Fecal coliform counts were low and met the Class AA marine criterion of 14 colonies/100 mls during each sampling event.

3.1.2 Impacts of Alternatives 1, 2, and 3

The proposed actions would include remediation of contaminated soils, and, under Alternatives 1 and 3, construction and maintenance of a golf course cap/containment facility. The remedial action would include scraping soils to the depth of contamination (estimated to be 1 to 1.5 feet), as defined by applicable regulatory standards, moving excavated soils into placement/consolidation areas (PAs), and, for Alternatives 1 and 3, construction of an engineered cap over PAs. Proposed actions related to the golf course include course construction and maintenance over an engineered cap. The following discussion summarizes the potential impacts to surface water.

Impact analyses for potential sources of surface water quality effects are based on excavation, disposition of excavated soil, and cap construction methods proposed by Weyerhaeuser and DuPont as part of the preferred alternative (Alternative 1). Alternatives 2 and 3 differ from Alternative 1 only in final disposition of soil and the amount of excavation, and Alternative 2 does not include the engineered cap containment. Therefore, the following discussion of excavation and placement under the engineered cap applies only to Alternatives 1 and 3.

Excavation and Soil Placement

Details of the mass excavation and soil placement were presented previously in Chapter 2. Elements of these activities that would potentially impact surface water include:

- Vegetation clearing
- Temporary haul route building
- Mass excavation and placement of soils
- Soil stockpiling

Clearing Vegetation

The clearing of existing vegetation and ground cover would significantly decrease the stability of site soils for all three action alternatives. Clearing activity such as equipment movement, haul route building, and timber cutting would be an initial mechanism for erosion and sedimentation. The resultant lack of vegetation would expose soil to further degradation by eliminating foliage protection, the evapotranspiration process, and the physical stability provided by plant root systems. Without this protection, and depending on topography and location of erosive areas, the potential for sedimentation and/or siltation in onsite and adjacent surface water would increase. If there is a significant time lapse between clearing vegetation and scraping contaminated soil, the potential for contaminant transport via sedimentation would also increase.

Overall, impact to surface water from clearing vegetation would be low under Alternative 1 (the proposed action) because the majority of the project site is relatively flat. In addition, clearing would not take place on adjacent steep slopes parallel to Puget Sound and Sequalitchew Creek and in the Old Fort Lake setback. Remedial scraping at the site will frequently remove the overlying humus and soils, exposing the high permeability Steilacoom Gravels, or leave a thin layer of overlying soil. This will result in rapid infiltration of precipitation and reduce any ponding on the surface. The potential for contaminant migration after clearing would be reduced by the hot spot removal action (discussed in Chapter 2).

Two areas have a slightly higher potential to be impacted due to vegetation clearing: a slope just inside the western boundary of the project site and a large swale on the left bank, looking upstream, of Sequalitchew Creek, approximately 3,000 feet upstream from the creek outlet. Just inside the western boundary of the site, east of the adjacent steep slope, the ground surface descends toward the steep slope with a grade up to 30 percent. The swale above the left bank of Sequalitchew Creek drains from a location approximately 1,000 feet southwest of the creek. Clearing vegetation in these areas would subject the slopes to erosion, formation of rills and gullies, and increased sheet flow. Storm water drainage on these slopes could increase sedimentation in Puget Sound and in the lower reaches of Sequalitchew Creek. Sequalitchew Creek could also be impacted by increased siltation. However, no remediation activities are anticipated in either area.

An indirect impact resulting from vegetation clearing would arise from decontamination and maintenance of equipment. The proposed project would require the construction of decontamination pads and all necessary facilities for handling decontamination and maintenance waste. The impact to surface water would be nonexistent or low if best management practices (BMPs) were followed in locating, constructing, and maintaining these facilities.

Scraping and Placement of Soil

All three action alternatives would include mass excavation. Mass excavation would include scraping, grading, pushing, and transporting soil. Soil placement activities would consist of transporting, pushing, and placing soil with lead and arsenic concentrations below golf course remediation levels into PAs. These activities would loosen surface soil, destabilize slopes, create dust and involve filling in kettles. Loosening surface soil and destabilizing slopes increase the potential for erosion, thereby increasing the potential for sedimentation and contaminant transport. Siltation and elevated contaminant levels in surface water could result, although as noted above, the exposed gravels will result in rapid infiltration. During dry periods, dust and associated contaminants could migrate to surface water via wind action. Soil placement into kettles would modify natural surface water collection areas.

A significant impact to surface water would not be likely from excavation activities on the relatively flat portion of the project site. Overall, a long-term enhancement of surface water could result from removal of contaminated soils. The potential for stormwater and wind transporting dust and contaminants to surface water on and adjacent to the site would be significantly decreased as a result of the proposed project.

If remediation efforts occur in these areas, some potential exists for erosion, sediment movement, or slope failure along the western boundary and in the swale at the bend in Sequalitchew Creek. These conditions may impact Puget Sound, water in Sequalitchew Creek downstream of the swale, and water in the Nisqually mudflats. If the slopes are scraped or left exposed during the wet season (October to April), sediment and contaminant transport toward surface water and/or mass failure could occur. A temporary erosion and sediment control plan (TESCP) would be implemented in accordance to the Pierce County Stormwater Management Manual (Pierce County, 1997) to prevent or minimize these occurrences. In addition, the roads inside and outside the perimeter fence provide additional protection against erosion by providing a barrier to transport of sediments and contaminants. No remediation is anticipated in these areas.

Temporary Haul Route Building

Haul routes would be constructed or repaired prior to initiation of the scraping program under all three action alternatives. Impacts to surface water from route construction would be similar to impacts from soil excavation. Equipment traveling on the route may transport contaminants across the site and create dust. Because soils in hot spots have been cleared prior to scraping, the potential for contaminant transport would be reduced. The impact to surface water from road dust would also be minimal. Roads left in place during the wet season (October to April) may be pathways for stormwater drainage and sediment movement. Depending on topography and the proximity of the road to surface water, the impact of the roads as flow paths would be variable.

Stockpiling Soils

Temporary stockpiles would be created under Alternatives 2 and 3. Alternative 1 would minimize stockpile development by moving soils with lead and arsenic concentrations below golf course remediation levels directly into PAs. Including soils developed during the hot spot removal program, there are currently over 110,000 cubic yards of stockpiled soils on the site. Soil stockpiles are especially vulnerable to wind and stormwater erosion because of low stability and steep surfaces. Mitigation measures such as visqueen covers are difficult to maintain and soil is easily exposed. If stockpiles are left uncovered or remain onsite for extended periods of time, the potential for surface water impact by sedimentation and contaminant transport would be high in areas near surface water. However, there are no stockpiles near any surface water body. Historically, actions associated with this project have not impacted surface water from stockpiles. A beneficial impact would result from moving stockpile soil offsite, soil washing/dry screening, or placing existing stockpiles into PAs or disposal by other means.

Cap Construction

Impacts to surface water from cap construction activities would be minimal. Soils placed in the footprint of the cap would be temporarily subject to wind and stormwater. However, by following BMPs it is unlikely that drainage from the site would transport sediment or contaminants from the PAs to surface water. Overall, the completed cap would have a beneficial impact by covering contaminated soils that are currently exposed.

Alternative 1

The two primary potential sources of surface water quality impacts from Alternative 1 would be sediment movement and contaminant transport via wind and stormwater drainage. Clearing vegetation, scraping, and placing soils with lead and arsenic concentrations below golf course remediation levels into PAs would erode or expose soils to erosion. These effects would be short-lived, and cap construction would have an overall beneficial impact to surface water because surface water would no longer be in contact with contaminated soils and the water would be directed in defined drainage pathways. Groundwater from onsite irrigation wells, which contains low levels of dinitrotoluene, would be used to maintain the grass cover over the cap/containment facility. Use of that water would not cause adverse impacts to surface water quality via either infiltration or direct runoff to surface water.

Alternatives 2 and 3

Alternatives 2 and 3 differ from Alternative 1 only in that excavated soils would be disposed of offsite or treated onsite by soil washing. Impacts to surface water from these activities would be similar to impacts from Alternative 1. An additional difference would be the minimization of stockpiles under Alternative 1.

3.1.3 Impacts of Alternative 4

The site and the existing water quality would remain as they currently exist for the foreseeable future under Alternative 4. The remediation studies of the site are focused on elevated concentrations of lead and arsenic in soils at specific locations and have not identified surface water quality concerns that require remediation. Considering that this option would not be allowed under MTCA, there is a low likelihood that any existing condition would exist as it currently is for the foreseeable future.

3.1.4 Mitigation Measures

Certain mitigation measures would be required for the remedial action, while others would be recommended but not mandatory. Measures in each category for construction and operation are summarized below.

In general, determination of needed mitigation measures related to surface water considerations would be the responsibility of Ecology. Mitigation measures would be accomplished through required compliance with a Best Management Practices (BMP) manual. The BMP would address the substantive requirements of local ordinances that typically apply to development activities. Consequently, the following discussion addresses measures that would typically be required by the City of DuPont, some of which would presumably be incorporated into Ecology's requirements.

The City of DuPont requires all new development to follow the *Pierce County Stormwater Management Manual* (Pierce County 1997) minimum requirements for stormwater control, which include erosion and sediment control provision (Section 18C.30.040 of Site Development Title 18C) during the construction phase of development. Such measures include sediment ponds, silt fences, gravel filters, and vegetated interceptor swales as warranted by water velocities and site slopes. The Pierce County manual is based on Ecology's stormwater manual, and it is assumed that Ecology would require the same or equivalent measures through its BMP manual for the remediation. Stormwater control mitigation may include the following:

- A TESCP would be submitted to Ecology as part of construction-level applications.
- A pollution prevention plan would be submitted to Ecology as part of a National Pollutant Discharge Elimination System (NPDES) permit application for construction on the site.
- Soil stockpiles or exposed slopes may require mulch or cover as required in the Pierce County (1997) manual. However, current site stockpiles have been without cover for many years without any erosional damage.

In addition to the above elements for an erosion and sediment control plan, the following mitigation measures are recommended for the construction phase of the proposed golf course footprint:

- Construction runoff (e.g., concrete wastes, equipment oils) would be collected in sumps and disposed of in approved offsite facilities.
- A water quality/TESCP inspector would be present during site preparation activities as part of the TESCP (this function might be undertaken by onsite Ecology personnel).
- Sediment ponds would be finished to or above final grade elevation during construction to retain/infiltrate runoff during construction, allowing for cleanout of ponds to finish grade elevation after site stabilization.
- Accidental spill response cleanup and notification procedures would be included in construction contractor agreements.
- Wet ponds (golf course footprint area) would be lined, providing dead storage for particulate/contaminant settling prior to discharge to infiltration systems constructed in conjunction with the golf course footprint (Alternative 1).
- The natural recovery of vegetation scraped areas will reduce surface water quality/quantity impacts after construction.

3.1.5 Significant Unavoidable Adverse Impacts

Based on the assumption that BMPs would be adhered to during the proposed project, no significant unavoidable adverse impacts to surface water are anticipated.

3.2 GROUNDWATER

Groundwater information discussed below for the proposed remediation is summarized from the draft RI prepared for the site (DuPont Environmental Remediation Services and Hart Crowser, 1994b) and from a draft environmental document for the golf course (Huckell/Weinman 1998). These documents provide a more comprehensive presentation of hydrogeology and groundwater conditions at the site.

3.2.1 Affected Environment

Site Hydrogeology

Two aquifers comprise the relevant hydrogeologic system beneath the project area. These aquifers are:

- The Water Table Aquifer, a shallow unconfined aquifer in the Vashon Drift sediments
- The Sea Level Aquifer, a deeper, semi-confined aquifer in the Salmon Springs Formation and the Steilacoom Gravel

The Water Table Aquifer occurs within the saturated portions of the Steilacoom Gravel and Advance Outwash units within the Vashon Glacial Drift. The aquifer is recharged by precipitation infiltrating through overlying permeable soil. Groundwater in the Water Table Aquifer is encountered at depths of approximately 20 to 30 feet bgs at elevations of about 190 to 220 mean sea level (msl) in the eastern portion of the site, and approximately 110 to 120 feet below ground surface (elevations of 90 to 100 feet msl) near the western termination of the Kitsap Formation.

Groundwater flow in the Water Table Aquifer is generally to the west-northwest, toward Puget Sound. Groundwater from this aquifer discharges into the Steilacoom Gravel at the western edge of the aquifer, flowing over the Kitsap Formation and into groundwater within the unconfined portion of the Sea Level Aquifer (DuPont Environmental Remediation Services and Hart Crowser, 1994b). The groundwater flow rate in the Water Table Aquifer beneath the site is approximately 1 to 22 feet/day or about 400 to 8,200 feet/year. Aquifer tests indicated that lower gradients (and correspondingly 5 to 20 percent lower flow rates) occurred in December 1992 compared to April 1992.

The Sea Level Aquifer underlies the Water Table Aquifer. The two aquifers are separated by the Kitsap Aquitard, a low-permeability unit that extends across most of the site (DuPont Environmental Remediation Services and Hart Crowser, 1994b). The Sea Level Aquifer is divided into two distinct portions, based on location east or west of the western edge of the Kitsap Formation.

The east (upgradient) portion of the Sea Level Aquifer is in the permeable deposits of the Salmon Springs Formation, located immediately below the Kitsap Aquitard. Depths to this portion of the aquifer range from 150 to 170 feet bgs (DuPont Environmental Remediation Services and Hart Crowser, 1994b). For the most part, the Sea Level Aquifer is regionally confined. However, near the western edge of the Kitsap Formation, the artesian pressure of the aquifer is dissipated and the aquifer becomes unconfined, reflecting semi-confined or water table conditions. Therefore, this aquifer is considered to be semi-confined beneath the site. The groundwater flow rate in this portion of the Sea Level Aquifer is approximately 0.3 to 2 feet/day, or 120 to 600 feet/year. Aquifer tests indicated that groundwater velocities were approximately 10 percent lower in December 1992 than in April 1992, due to lower gradients at the time (DuPont Environmental Remediation Services and Hart Crowser, 1994b).

The west (downgradient and unconfined) portion of the Sea Level Aquifer is within saturated delta materials of the Steilacoom Gravel. The water table within this portion of the aquifer is approximately 160 to 200 feet bgs. The unconfined portion of the aquifer receives discharge from the Water Table Aquifer and the semi-confined eastern portion of the Sea Level Aquifer. The groundwater then continues its westward flow until it is discharged to Puget Sound via seeps in the deltaic materials, which terminate in the Sound. Groundwater flow velocities in the unconfined portion of the Sea Level Aquifer range from approximately 2 to 200 feet/day, or about 800 to 80,000 feet/year. Similar to the Water Table Aquifer, aquifer testing indicated that lower groundwater gradients (and 5 to 20 percent lower groundwater flow rates) occurred in December 1992 compared to April 1992.

The Sea Level Aquifer is highly productive in terms of groundwater yield (Brown and Caldwell, 1985). Upgradient portions of this aquifer are the source of drinking water for many Puget Sound municipalities, including Tacoma, DuPont, and other municipalities in Pierce County. Three production wells formerly used by the DuPont Works are located in the northwestern portion of the site. These wells are screened in the Sea Level Aquifer. Ecology recently completed negotiations with Weyerhaeuser to consolidate water rights and issue permits that would allow Weyerhaeuser to use up to a total of 1,250 gallons per minute (or 695 acre-feet per year) to meet the irrigation needs of the approximately 200-acre golf course (Walsh, 1997). This aquifer has been assessed by Ecology as being sufficient to provide this demand, given the relatively high productivity of the aquifer in the project area.

Groundwater Quality

Groundwater Investigation

Initial sampling episodes at the site, referred to as the pre-RI investigations, commenced with the collection of samples from seeps and surface water at the site in December 1986. Investigators installed 17 initial monitoring wells in late 1987 and early 1988, and sampled these wells and nearby springs and fire protection wells. Nine additional wells were added to the program during the RI process. Groundwater monitoring wells at the site were screened in both the Sea Level and Water Table Aquifers. Groundwater quality data collected at the site from December 1988 through October 1994 are presented and analyzed in the draft RI for the site (DuPont Environmental Remediation Services and Hart Crowser, 1994b).

Quarterly groundwater sampling continued at selected wells for one analysis (Nitroamine Explosives or NAX) through October 1997. In March 1998, following receipt of an assessment indicating the lack of seasonal changes in the groundwater quality at the site, Ecology agreed to a request by the Weyerhaeuser and DuPont companies to reduce the periodicity of groundwater sampling from quarterly to annual (Blum, personal communication 1997). Annual groundwater sampling events were performed in March 1998 and March 1999. Groundwater monitoring at selected wells for NAX only is scheduled to be performed until Ecology determines concentrations of dinitrotoluene (DNT) in the selected wells are below drinking water levels.

Background groundwater quality results (DuPont Environmental Remediation Services and Hart Crowser, 1994b) indicated the presence of constituents in one or more of the samples taken from the background wells that included several metals (total and dissolved aluminum, cadmium, and zinc; dissolved antimony; total lead); nitrate; and phenanthrene (a noncarcinogenic PAH). Total and dissolved aluminum were the only constituents detected in one or more background wells that were above the MTCA drinking water screening level. In this case, the exceeded level was the 0.05 mg/L secondary drinking water standard for aluminum, which (like all secondary drinking water standards) is established for aesthetic conditions (such as taste, odor, and color), rather than on human health risk.

A statistical screening evaluation of site groundwater quality data collected during the RI indicated that only DNT, nitrate, and the carcinogenic PAH (cPAH) chrysene were detected above the MTCA screening level for drinking water in one or more locations (DuPont Environmental Remediation Services and Hart Crowser, 1994b). Concentrations of DNT in groundwater at the site during the March 1999 sampling round did not exceed MTCA drinking water standards in any of the seven currently monitored groundwater monitoring wells. DNT concentrations are expected to gradually decrease over time as a result of source removal activities that have been completed at the site. Data collected in March 1999 showed decreases in DNT for the groundwater monitoring wells compared to previous years. However, trends are difficult to determine because DNT fluctuations have been only a few parts per billion or less. DNT concentrations measured throughout all of the monitoring period have been below levels of concern for the protection of the receptor surface waters of Puget Sound.

Nitrate also was detected in 1988 in three monitoring wells; nitrate concentrations were below the screening level in the eight subsequent rounds of monitoring. Ecology has agreed that nitrate in groundwater is not a constituent of concern at the site.

One cPAH (chrysene) was detected inconsistently in 15 of the 128 RI groundwater samples, and no cPAH concentration was above the 0.1 micrograms per liter (μg/L) MTCA screening level for total cPAHs (excluding one unconfirmed sampling concentration). Therefore, Ecology has agreed that PAHs in groundwater are not constituents of concern at the site.

Groundwater Remediation Activities

The interim source removal activities conducted from 1990 to 1994 eliminated many of the known discrete sources of potential contamination to groundwater at the site. According to Ecology (Blum, personal communication 1997), groundwater contamination levels are relatively low and the only constituent detected in groundwater that has been above screening levels is DNT. Dissolved lead or arsenic has not been detected in groundwater at concentrations above screening levels.

The planned remediation of contaminated soil (including treatment/offsite disposal of soil contaminated above risk-based levels and consolidation of lesser-contaminated soil under clean fill) will result in further limiting the potential for future groundwater quality degradation at the site, although the remediation activities are not being implemented to address groundwater contamination due to soil contamination. The purpose of the additional soil remediation is to prevent direct contact with residual lead and arsenic in soils. On the basis of site-specific leaching studies using EPA protocols, the arsenic and lead in soil have been demonstrated to have limited or no potential to leach into groundwater (Hart Crowser, 1996). On the basis of a "substantial and disproportionate evaluation of cost and reduction in risk," Ecology has recommended that no additional remediation of groundwater at the site is necessary. Continued groundwater monitoring at selected locations for DNT will likely be continued as part of future site remediation.

3.2.2 Impacts of Alternatives 1, 2, and 3

The groundwater impact analysis is based on the proposed action and site cleanup that are described in Chapter 2.

Groundwater Quality

The proposed action would not be expected to cause significant adverse impacts to groundwater quality. Groundwater contamination at the site (based on ongoing post-RI quarterly sampling) remains relatively low. Concentrations of DNT measured in groundwater samples from the most recent groundwater monitoring event (March 1999) were below all screening criteria. In addition, the interim source removal activities conducted at the site from 1990 to 1994 were directed at eliminating many of the identified discrete sources of potential contamination to the groundwater. The interim hot spot removal and soil scraping outside of the golf course footprint (described in Chapter 2) would remove contaminated soils and dispose of them offsite or beneath the engineered cap underneath the golf course.

As a result, contaminant leaching (to groundwater or other media) following remediation would not result in impacts to human health or the environment. This is based on the RI and RA conclusions concerning sampled concentrations in surface water and groundwater, which resulted in the FS remediation alternatives focusing on arsenic and lead present in soil and debris only. The assumption is also based on site data that indicate that all media are in compliance with MTCA standards except for direct contact with soils and DNT in groundwater, and on site-specific studies demonstrating that there is little or no leaching potential for lead and arsenic (Hart Crowser, 1996).

Soil scraping activities associated with each action alternative would also be unlikely to cause impacts to groundwater quality. Remedial soil scraping and construction excavations would not likely extend to the Water Table Aquifer, which is generally 20 to 30 feet bgs at the site. Excavations might occasionally encounter perched groundwater; however, these impacts (sedimentation, possible carrydown of contaminants from surface soil) would be minimal due to the isolation of impacted groundwater from underlying aquifers and standard construction impact mitigation practices described below. Dust control measures involving wetting of exposed soil would not require sufficient water to cause infiltration of contamination to the underlying Water Table Aquifer.

Soil scraping associated with remediation would remove potential contaminants from soils located outside of the cap/containment area and would, therefore, not cause impacts to groundwater quality in these areas. Technical assessments indicate that leaching of lead and arsenic from contaminated soil incorporated into the golf course design would not occur (Hart Crowser 1996; Blum, personal communication 1997).

Contaminants associated with future golf course construction and maintenance activities, including fertilizer, pesticides, and herbicides, have the potential to be carried down to the Water Table Aquifer via infiltrating irrigation water. Because of the depth to groundwater (greater than 30 feet), migration of contaminants from shallow depths downward via pathways resulting from burrowing organisms (e.g., worms) is unlikely.

No chemicals and/or petroleum hydrocarbon products would be handled in areas outside of the cap/containment facility during remediation activities. In the cap/containment facility area, Alternative 1 would increase the potential for groundwater quality to be degraded as a result of spills, leaks, or other releases of chemical and/or petroleum hydrocarbon products handled at the remediation staging area. Products that could be expected to be handled at the staging area during construction of the golf course footprint include fertilizers, pesticides, herbicides, gasoline, and lubricating oils.

The highest probability of release of these materials would occur during handling (such as transfer of products from containers to equipment or movement of products). Under Alternatives 1 and 3, management and handling of these materials would be in accordance with procedures that would be established in a management plan governing golf course construction, which would include waste-management requirements contained in the Washington State Dangerous Waste Regulations (WAC 173-303).

Stormwater also has the potential to impact groundwater quality if it transports contaminants and/or infiltrates through contaminated soil to groundwater. Contaminant transport by stormwater would not be a concern in areas of the site outside the golf course footprint because, under Alternatives 1 and 3, the contaminated soils above site-specific cleanup levels would have been removed (under Alternative 2, all contaminated soils above site-specific cleanup levels would have been removed). Under Alternatives 1 and 3, stormwater at the golf course footprint site would be managed by construction of temporary stormwater basins. Infiltration of stormwater would be accomplished through these basins.

After management of the property goes to WRECO/Northwest Landing, individual property owners would be responsible for controlling stormwater on their own sites. Management of stormwater runoff from a future golf course would be primarily through infiltration. Infiltration would occur during temporary ponding in depressions on the golf course and/or infiltration basins designed to accommodate up to a 100-year storm. Infiltration facilities would be located in areas or constructed in a manner where infiltration would not occur through contaminated soil. Treatment prior to infiltration is not expected to be necessary. Measures to control stormwater runoff and minimize runoff contamination are discussed in Section 3.1, Surface Water.

Groundwater Quantity

Groundwater would be used for dust control during remedial action and construction. After remedial action and construction, groundwater use for Alternatives 1 and 3 within the cap/containment facility area would be limited to irrigation. Drinking water would be provided by the City of DuPont from the City's drinking water resources. Groundwater for irrigation would be pumped from existing production wells at the site that were formerly used to provide water to support explosives manufacturing. These wells are screened within the Sea Level Aquifer (Germiat, personal communication 1998).

Based on likely evapotranspiration rates for a future golf course (assuming that 60 percent, or 108.5 acres, of the total area of the golf course would be irrigated), approximately 37.1 million gallons of water would be required to irrigate the course. The need for irrigation would be limited to the months of May through September; normal rainfall would provide adequate irrigation in other months. Required irrigation water would range from a low of approximately 2.7 million gallons (or approximately 89,000 gallons per day) in May to a high of 10.1 million gallons (or approximately 338,000 gallons per day) in August. The 1,250 gallons per minute (gpm) permitted for irrigation use from the existing production wells would easily accommodate the maximum irrigation needs posed by a fully developed golf course. These required volumes might be further reduced by the extent to which surface water runoff could be impounded and recovered for supplemental use as irrigation water.

Typical yields inferred for the Sea Level Aquifer, particularly in areas close to Puget Sound, suggest that a proposed golf course's irrigation water demand could be met without adversely affecting either streamflow in Sequalitchew Creek or the productivity of the upgradient drinking water wells operated by the City of DuPont (Hart Crowser 1992), which are screened within the Sea Level Aquifer and/or the underlying undifferentiated materials of the deeper Lakewood Glacial Aquifer (Germiat, personal communication 1998). The Lakewood Aquifer underlies the Sea Level Aquifer and is not related to the hydrology of the site with respect to effects of the proposed action.

All three action alternatives include removal of contaminated soils from areas outside the golf course footprint at the project site. In addition, previous studies (Hart Crowser 1996; Blum, personal communication 1997) have demonstrated that there is little or no leaching potential of contaminants (lead and arsenic) from soil. Given these conditions, and the remedial and operational elements that are common to all three alternatives, there would be no significant differences in impacts to groundwater among the three action alternatives. The impacts of Alternative 2 or 3 on groundwater quality and quantity would be expected to be virtually identical to those identified above for the Alternative 1.

3.2.3 Impacts of Alternative 4

Under the no action alternative, the proposed project would not be implemented at present and the site would remain undeveloped in the near term. Impacts identified for the proposed action would generally not occur; that is, no changes would occur to existing groundwater resources. There would be no impacts to site topography, geology, or soil with the potential of impacting groundwater under the no action alternative. However, unidentified future projects that might be proposed for the site could result in modifications to these conditions.

The project site remediation measures include scraping and removal of contaminated soils from areas outside the golf course footprint at the site, and the use of the golf course footprint to consolidate, isolate, and cover contaminated soil from nearby areas as part of the project, as well as the mitigation measures pertaining to golf course development and operation, would not be implemented in the foreseeable future under this alternative. A remediation strategy for the site would still need to be developed to address soil contamination at the site. Groundwater monitoring would most likely be continued as part of any site remediation undertaken in conjunction with adoption of the no action alternative. Any remedy undertaken at the site might have a net positive impact on groundwater quality compared to the failure to implement a remedy, although the site studies have not identified groundwater as a medium that is out of compliance with standards, except for DNT.

3.2.4 Mitigation Measures

Many effective mitigation measures designed to provide protection to groundwater resources at the project site have been assumed to be incorporated into the proposed action, or to occur as part of the planned site remediation, based on measures expected to be required by Ecology. For example, continued groundwater monitoring is planned for the site as part of the ultimate site remediation. Other mitigation measures incorporated into Alternatives 1 and 3 that would be directed at protecting groundwater resources include:

- All ponds within the golf course area footprint would be lined or sealed to minimize infiltration. No contaminated soils would be present in golf course footprint pond areas.
- Implement strict operational and spill control practices at the remediation staging area.
- A maintenance plan for the cap/containment facility would be prepared as part of the Cleanup Action Plan.
- Institute stormwater controls during project operation, and temporary erosion and sediment control plans during construction (as discussed in the Section 3.1).

Under Alternatives 1 and 3, the capping of contaminants with clean soil in the cap/containment facility would be undertaken to prevent direct contact to the contaminants but allow water infiltration. Ecology has determined that the principal contaminants present in the soil (arsenic and lead) are unlikely to leach and should not pose a risk of groundwater contamination.

Alternative 2 would only have the temporary potential for groundwater impacts during soil removal and offsite disposal and, therefore, would have the minimum potential impacts to groundwater due to the limited duration of the remedial actions.

Alternative 4, the no action alternative, would not create any new groundwater impacts and would not require any associated mitigation measures. Ecology has determined that the principal contaminants present in the soil (arsenic and lead) are unlikely to leach and should not pose a risk of groundwater contamination.

3.2.5 Significant Unavoidable Adverse Impacts

The net impact of remediation activities and construction activities on local groundwater resources would be very low, and perhaps negligible, for any of the three action alternatives. Under Alternatives 1 and 3, activities at the remediation staging area would increase the risk that new contaminants would be introduced to groundwater through spills or accidents. However, the mitigation measures incorporated into the proposed action would reduce the net potential impact of these activities. No significant unavoidable adverse impacts to groundwater have been identified or are anticipated.

3.3 HISTORIC AND CULTURAL RESOURCES

3.3.1 Affected Environment

The project vicinity has figured importantly in Nisqually Indian prehistory and ethnography as well as Euroamerican history. Prehistoric occupation dates to as early as approximately 5,700 years Before Present, according to radiocarbon dates of a shell deposit in the project site vicinity area (Wessen 1989). The project area lies within the aboriginal territory of the Nisqually Indian people, which encompassed the drainage of the Nisqually River system and adjacent Puget Sound shoreline (Smith 1940; Spier 1936). Villages often were located at the confluences of larger streams and where larger streams emptied into Puget Sound. Many of these villages occurred along the streams in the Nisqually River drainage. The village closest to the project area was located along Sequalitchew Creek (Smith 1940:13).

The project vicinity was the setting of the earliest Euroamerican structure on Puget Sound when the Hudson's Bay Company built a storehouse in 1832 and Fort Nisqually in 1833 for fur trading with the Indians, followed by the Hudson's Bay Company's Puget Sound Agricultural Company in 1839 for farming to support the Company's international trade.

From 1906 to 1976, the E.I. du Pont de Nemours & Company owned the property and developed it for industrial use. DuPont's powder works produced explosives that were subsequently used in construction and resource extraction. In recent years, site remediation activities have occurred within the Consent Decree boundary. A detailed discussion of the prehistory and history of the site is contained in a separate document entitled *A Cultural Overview and Comprehensive Management Plan for the DuPont Property, Pierce County, Washington* (Western Heritage Inc., 1989).

Since Weyerhaeuser acquired the property in 1976, numerous archaeological and historical surveys, investigations, excavations, and studies have been conducted pertaining to the property. The studies are listed in Appendix A.

The project area and adjoining property have also been extensively investigated for archaeological and historic sites. The project area and adjoining property include sites listed or eligible for listing in the National Register of Historic Places (National Register) as well as other sites, many of which are not eligible for listing on the National Register.

In addition, a memorandum of understanding (MOU) and two memoranda of agreements (MOA) have been signed among Weyerhaeuser and several affected parties. Copies of these documents are included in Appendix B.

For reference purposes, there are only a few remaining buildings (DuPont Powder Works) onsite. The sites described below do not exist as structures.

The following is a summary of the archaeological and historic sites located within the project area or adjoining property and potential impacts to such sites. The sites are shown on Figure 6.

- **Site 45-PI-54 (Nisqually House/Sequalitchew Village Site).** Site 45-PI-54 is listed on the National Register. The site is located just outside the northwest project area boundary in a sensitive buffer area. This site will not be affected by the remediation activities.

- **Site 45-PI-55 (Hudson's Bay Company's 1833 Fort Nisqually Site).** Site 45-PI-55 is listed on the National Register. The site is located within the project area. The site, however, is located within an area that will not be scraped as part of the remediation and is surrounded by wood post barriers and a buffer to prevent disturbance.
- **Site 45-PI-56 (Hudson's Bay Company's 1843 Fort Nisqually Site).** Site 45-PI-56 (Fort Nisqually and possibly some agricultural infrastructure) has been nominated and recommended for listing on the National Register. The site is located outside the project area, and will not be affected by the remediation activities.
- **Site 45-PI-63 (Railroad Dump No. 3 Site).** Site 45-PI-63 is located in the project area. The site, which has been vandalized extensively over the years by relic collectors, has been determined not to be eligible for the National Register (no historic integrity) by the State Office of Archaeology and Historic Preservation (OAHP). The site will not be affected by the remediation activities.
- **Site 45-PI-66 (Methodist Episcopal Mission Site).** Site 45-PI-66 is located within the project area. A monument marker has been established in the general vicinity of the former site. Nearby, there was also an encampment of Buffalo Soldiers. The area will not be affected by the remediation activities. The site may be eligible for the National Register.
- **Site 45-PI-67 (Wilkes Observatory Site).** Although Site 45-PI-67 has not been located, the site's general vicinity is located outside of the project area. This site will not be affected by the remediation activities. There is an open question as to its eligibility for the National Register.
- **Site 45-PI-70 (DuPont Powder Works Site).** Site 45-PI-70 is located within the project area. The site has been and will be impacted by remediation activities. The site has been determined not to be eligible for the National Register by the OAHP.
- **Site 45-PI-72 (DuPont Southwest Site).** Site 45-PI-72 is located within the project area. However, the site is located within a bluff-edge greenbelt area that will not be affected by the remediation activities. The site is likely to be eligible for the National Register.
- **Site 45-PI-73 (Indian House Site).** Site 45-PI-73 is located within the project area. This site has lost its historic integrity (destroyed by DuPont era facility construction). This site has been surveyed and inventoried but, apparently, no cultural remains were found. This site could be further affected by the remediation activities. The site may be eligible for listing on the National Register.
- **Site 45-PI-74 (Mens' Dwelling Houses).** Site 45-PI-74 is located outside the project area and will not be affected by the remediation activities. A portion of the site has lost its historic integrity. Further evaluation to determine historic integrity and its eligibility for the historic register may be necessary.
- **Site 45-PI-75 (Crystallizer Site).** Site 45-PI-75 is located within the project area. The site, however, is within an area of open space and may or may not be affected by the remediation activities. The site has been determined not to be eligible for the National Register by the OAHP.

- **Site 45-PI-77 (Old Fort Lake Grave Site).** Site 45-PI-77, which was supposedly located in the project area, was alleged to contain the graves of the McAllister family members and others; however, a survey and inventory was conducted and no graves or other cultural materials around Old Fort Lake were located. Subsequent research revealed that the graves of McAllister family members and others are in the Tumwater Masonic Cemetery.
- **Site 45-PI-404 (Nisqually Burial Site).** Site 45-PI-404 is located within the project area. This site, however, is located in an area that may or may not be scraped. This former grave site probably has lost its historic integrity (the remains have been reinterred in the Sequalitchew Indian Cemetery). The site is not eligible for listing on the National Register.
- **Site 45-PI-405 (Nisqually Village Site).** Site 45-PI-405 is located outside the project area. The site will not be affected by the remediation activities. The site may be eligible for the National Register.
- **Site 45-PI-452 (Ox Road Site).** Site 45-PI-452 is located outside the project area. This site will not be affected by the remediation activities. The site may be eligible for the National Register.

In addition, there has been a proposal to list a portion of the project area on the National Register as an historic district. This proposal was considered by the State Advisory Council on Historic Preservation at their January 28, 2000, meeting. The Council has recommended that the OAHP forward the proposed district to the U.S. Department of Interior – National Park Service for their consideration. Final determination of eligibility for listing has not yet occurred. This proposal was not supported by the landowner. Accordingly, pursuant to federal law, no such historic district may be established or listed on the National Register.

3.3.2 Impacts of Alternatives 1, 2, 3, and 4

The potential impacts of the project alternatives on historic and cultural resources could be either direct or indirect, depending on the timing and location of activities associated with the alternatives. The potential project impacts are summarized below for each cultural site – including sites that are listed or have been nominated and recommended for listing on the National Register as well as sites that are not eligible for listing on the National Register. Under Alternative 4 (the no action alternative), there are no anticipated impacts to historic and cultural resources although the contamination in Parcel 1 will be left unremediated. All of the project alternatives (1, 2, and 3) would generally have the same potential effects on each site. In addition, it is possible that historic or cultural materials not associated with any of the sites could exist within the project area. Those sites or artifacts that are deeply buried could be uncovered during construction activities or buried deeper during construction of the cap/containment facility.

- **Site 45-PI-54 (Nisqually House/Sequalitchew Village Site).** This site is outside the project area boundary and would not be affected by construction under any of the alternatives. Therefore, no project impacts are anticipated.
- **Site 45-PI-55 (1833 Fort Nisqually Site).** This site is within a Weyerhaeuser "protected area," including a wood-post barrier and an additional 63-foot buffer zone. Weyerhaeuser and the DuPont Company are committed to taking extra precautions when work is under way

or will occur in the vicinity of the site. All of the project alternatives would maintain the site's protected status. Therefore, no project impacts are anticipated.

- **Site 45-PI-56 (1843 Fort Nisqually Site).** This site is outside the project area boundary and would not be affected by construction under any of the alternatives. Therefore, no project impacts are anticipated.
- **Site 45-PI-63 (Railroad Dump No. 3 Site).** This site, which is not eligible for the National Register (lost integrity), is located within the project area. Under the alternatives, the site could receive some impacts without mitigation.
- **Site 45-PI-66 (Methodist Episcopal Mission Site).** Excavations completed to date in the vicinity are over 150 feet from the existing monument marker. Further excavations may occur along the railroad corridor in this area, but no further excavations are planned in the vicinity of the marker. With construction monitoring around the marker, no project impacts are anticipated.
- **Site 45-PI-67 (Wilkes Observatory Site).** This site is outside the project area boundary and would not be affected by construction under any of the alternatives. Thus, no project impacts are anticipated.
- **Site 45-PI-70 (DuPont Powder Works Site).** This site is located within the project area. The few remaining DuPont Works buildings are to be demolished and properly disposed of as part of the site cleanup. There are concerns about the structural integrity of the buildings and there are also concerns regarding hazardous substances such as asbestos, lead-based paint, and contaminated soil surrounding the buildings. The former DuPont Powder Works site has been and will be impacted by remediation activities.
- **Site 45-PI-72 (DuPont Southwest Site).** This site is presently located in a bluff-edge greenbelt, which would remain as dedicated open space under each of the project alternatives. Thus, no project impacts are anticipated.
- **Site 45-PI-73 (Indian House Site).** If portions of this site remain (most likely destroyed by DuPont era facility construction), they could lie within or adjacent to the golf course footprint (Alternatives 1 and 3). Under the action alternatives, the site could receive construction impacts without mitigation.
- **Site 45-PI-74 (Mens' Dwelling Houses).** This site is located well outside the project area boundary and would not be affected by construction under any of the alternatives. Therefore, no project impacts are anticipated.
- **Site 45-PI-75 (Crystallizer Site).** This site, which is not eligible for the National Register, is located within the project area. Because the site is located in an area where some scraping could occur, there may or may not be impacts during construction.
- **Site 45-PI-77 (Old Fort Lake Grave Site).** This site, which is likely not eligible for the National Register, is located within the project area. At one time, it was believed the site was located near Old Fort Lake. Because the purported graves actually were not located within the project area (they are located in the Tumwater Masonic Cemetery), no project impacts are anticipated. Because the graves are not at this site, the site is not mapped on Figure 7.

- **Site 45-PI-404 (Nisqually Burial Site).** Although this site is located within the project area, it is located in an area that may or may not be scraped. Thus, there could be impacts even though the site probably has lost its historic integrity.
- **Site 45-PI-405 (Nisqually Village Site).** This site is located outside the project area and would not be affected by construction under any of the alternatives. Therefore, no project impacts are anticipated.
- **Site 45-PI-452 (Ox Road Site).** This site is outside the project area boundary and would not be affected by construction under any of the alternatives. Thus, no project impacts are anticipated.

3.3.3 Mitigation Measures

Proposed mitigation for impacts identified above are summarized as follows:

- Develop an investigative/survey plan for locations/areas/sites to be excavated/cleared. An archaeological and cultural resources protection plan is being prepared and will be implemented prior to construction. In general, the procedures include an archaeological survey of the area before logging or brush removal (already completed); a re-survey after logging; a re-survey after brush removal (if further testing is necessary, it will occur at this time); and finally, monitoring of surface scraping activities.
- Because of the potential for disturbance of known or unknown sites, a Professional Archaeologist (in accordance with Chapter 25-48-WAC) would monitor construction activities that would clear vegetation or disturb the soil.
- All construction and field personnel would be trained (for example, in the identification of potential cultural resources) prior to work beginning. This includes equipment operators and ground personnel who will be directing the equipment operators.
- In order to minimize potential impacts, construction scraping activities will occur in lifts (6 to 8 inches of soil at a time) to a depth of approximately 12 to18 inches. Each lift will be examined for potential artifacts.
- If monitoring reveals any grave site or human remains, work in that area would stop and the OAHP, Ecology, and the Nisqually Tribe would be notified.
- If monitoring reveals any significant cultural or historic site, OAHP and Ecology would be notified. Work in that area would stop until a decision is made.
- Weyerhaeuser will maintain a wood-post barrier around Site 45-PI-55 and have the site noted as off-limits in construction documents. Extra precautions will be taken for any construction activities in the vicinity of the site as well as other sites that may have cultural resources. In addition, to be certain no other human remains are in the vicinity of Site 45-PI-404, additional archaeological research will be scheduled in this area prior to the beginning of remediation work.
- The existing MOU and MOAs would be followed and/or amended as appropriate (existing MOU and MOAs are included in Appendix C).

- Ecology would ensure documentation on prehistoric and historic sites is forwarded to OAHP on a regular basis, as needed. Documents and review processes will be updated or established respectively, as necessary. Disposition of artifacts will be managed in accordance with existing agreements. Weyerhaeuser has ongoing efforts to catalog and protect artifacts.

3.3.4 Significant Unavoidable Adverse Impacts

Some historic and cultural resources and/or artifacts may be buried under the proposed cap/ containment facility or elsewhere. However, if the mitigation measures proposed above are followed, no significant unavoidable adverse impacts to historic and cultural resources are anticipated.

3.4 ENVIRONMENTAL HEALTH

3.4.1 Affected Environment

The interim source removal activities conducted at the site from 1990 to 1994 represented approximately 75 percent of the former DuPont Works site cleanup (Blum 1997). These activities resulted in the removal of substantial hazardous and dangerous waste from the site in the form of soil potentially contaminated with metals (lead, arsenic, mercury), petroleum, and chemicals associated with explosives manufacturing (DNT and TNT); drums; pipelines; underground storage tanks; and miscellaneous debris associated with manufacturing facilities and disposal areas.

Currently, approximately 35,000 cubic yards of relocated, stockpiled soil and an undetermined volume of undisturbed contaminated soil remain on the project site (Blum, personal communications 1997 and 1999). These soils are contaminated with lead, arsenic, mercury, TNT, MMAN, and petroleum constituents (petroleum hydrocarbons and cPAHs) at concentrations above screening levels. The contaminated soil is generally located within the top 1 foot of soil at former production and disposal areas located in the northwestern, central, and south-central portion of the project site.

Extensive air monitoring was done on both workers and within the work zone during interim source removal activities conducted between 1991 and 1994. The results of the monitoring allowed for a “downgrade” in worker protective equipment (from respirators to no respirators). In addition, there was no detectable impact to the soils immediately adjacent to the work area. This work, conducted in areas of high contaminant levels, indicates that there is little risk of exposure to contaminants from fugitive dust.

Concentrations of DNT in groundwater collected at the project site during the March 1999 sampling event did not exceed MTCA drinking water standards in any of the seven currently monitored groundwater monitoring wells. The concentrations have also been below the surface water screening level and, therefore, pose little to no risk to the environment. Minor exceedances of naturally occurring aluminum also occur in site groundwater and background (upgradient) groundwater. Nitrate exceedances of the drinking water standard were previously observed in some wells, although the source may have been offsite agricultural uses; recent samples (since 1988) from all monitoring wells have been below the drinking water standard.

Based on a "substantial and disproportionate evaluation of cost and reduction in risk," Ecology has recommended that no additional remediation of groundwater at the site is necessary. Continued groundwater monitoring at selected locations for DNT will likely be continued as part of future site remediation.

3.4.2 Impacts of Alternatives 1, 2, 3, and 4

Ecology has established a conceptual plan for future remediation to address soils that have contamination at concentrations higher than cleanup levels (Blum, personal communication 1997). The approach is based on minimizing direct human contact to contaminants. Elements of Alternative 1 to address this pathway of concern, and their associated environmental impacts, are presented below.

- A hot spot excavation program was conducted from the fall of 1999 through July 2000. During this interim action, soils containing lead or arsenic concentrations exceeding site-specific remediation levels were excavated and stockpiled. Excavated locations were primarily areas outside the proposed golf course footprint, and some localized areas were inside the golf course footprint. Hot spots have been removed to minimize the potential for direct contact by denying human and animal receptors access to contaminated soil through removal, cover, and/or location to all but remediation workers. Additional worker exposure to contaminated soil could occur under Alternative 3 during soil washing treatment.
- Locations to be scraped would be cleared and grubbed of existing vegetation, and soil would be removed to a depth of 1 to 1.5 feet. Removal of vegetation and soil would reduce available habitat for local plants and animals, until the site develops. In addition, it is possible that noxious weeds onsite could be spread over the site and possibly offsite.
- During construction or scraping activities, dust will be generated.
- Haul routes for the scraping program would be constructed or repaired. Construction of the haul routes and truck traffic may interfere with migratory patterns of local animals.
- Excavated soils less than the golf course remediation level would be placed in placement/consolidation areas (PA) in the golf course footprint and rough-graded to match the golf course design. These PAs would be entirely within the golf course footprint. The golf course would then be constructed as an engineered cover (cap) for contaminated soils and debris. The cap would consist of either 18 inches of clean soil over a geosynthetic layer or a 12-inch-thick "human health exposure" soil cap over a 6-inch gravel "eco-cap." Impacts to human health and the environment from construction of the golf course would include potential exposure to contaminated soils.
- For some open space land use areas (e.g., along railroad tracks), hot spots may need to be remediated. In other areas, lead detections occur in some open space areas that are ecologically sensitive: the Sequalitchew Creek Canyon (excluding railroad tracks), the bluff along Puget Sound, and the open space setback surrounding Old Fort Lake. These detections are low and below site-specific human health remediation levels. No remediation is planned for these areas.

Implementation of Alternative 2 or 3 would result in essentially the same consequences for human health and the environment as those discussed for Alternative 1. Alternative 4, the no action alternative, would result in the continuation of existing human health and environmental risks to those contaminants left in place.

3.4.3 Mitigation Measures

Under Alternative 1, the site remediation approach assumed by Ecology (which includes the placement of clean cover over contaminated soil, institutional controls, and other measures), in combination with land use design features, would provide adequate long-term human and environmental health protection. The following elements within the approach are designed to mitigate potential impacts of the remediation identified above.

- The time of exposure to these soils with elevated concentrations of contaminants would be short and workers would be wearing protective equipment, thereby mitigating human health impacts. Personal protective equipment (PPE) appropriate for the type of potential exposure would be worn to reduce worker exposure. Workers would be trained in the health and safety procedures appropriate for their respective tasks, and operation of equipment (trucks, backhoes, and other heavy equipment) would comply with appropriate safety regulations.
- Dust generation would be managed by wetting the soil during handling, paving the centralized treatment area, and/or covering stockpiles when not adding or removing material. Soil dampening will not be conducted on a 24-hour basis because the soil consists primarily of coarse-grained materials. To protect against changes in conditions during remediation activities, limited air monitoring will conducted in the work zone and surrounding areas. It is anticipated that after remediation, no soils exceeding cleanup levels will remain, and therefore, air monitoring would not be required.
- For open space areas with detections occurring in ecologically sensitive areas (the Sequalitchew Creek Canyon, the bluff along Puget Sound, and the open space setback surrounding Old Fort Lake), remediation may not occur, pending an evaluation of net environmental benefit, in order to maintain existing habitat.
- Precautionary measures would be taken to ensure noxious weeds are not spread over the site or offsite during construction.
- The area outside of the golf course footprint would be allowed to revegetate naturally because this land will be sold to companies who will develop the properties individually with structures, paved areas, and landscaped areas.
- A health and safety plan would be maintained during construction, and contaminated soils would be managed to reduce or eliminate human health and ecological risks.
- BMPs such as erosion and sedimentation control measures would be left in place after construction and monitored until no longer needed.

3.4.4 Significant Unavoidable Adverse Impacts

To prevent erosion and other impacts as noted in previous chapters, control measures would be left in place in the interim until full development of the site. A significant unavoidable adverse impact to habitat would occur until the site is developed.

3.5 LAND USE

3.5.1 Affected Environment

Existing land use conditions are described below for the site and the area surrounding the site. Figure 7 shows the existing land use in the project vicinity. The following land use discussion was adapted from the land use analysis conducted by Huckell/Weinman Associates, Inc. for a previous environmental document (unpublished).

The City of DuPont encompasses approximately 5.8 square miles (3,736 acres) of land within southwestern Pierce County. The City incorporation boundaries are generally defined by the Puget Sound shoreline along the northwest, DuPont-Steilacoom Road on the east, and Interstate 5 (I-5) and the Fort Lewis Golf Course on the south. The Fort Lewis Military Reservation, which includes approximately 86,000 acres, borders the City on the northeast, east, and south. The Nisqually National Wildlife Refuge is located on the tidal flats just south and west of the DuPont shoreline along Puget Sound. The communities of Steilacoom and Lakewood are located approximately 5 miles to the north and northeast of the City, respectively.

Existing developed land uses account for a small proportion of the total area within the City. Until 1994, virtually all development within the City was confined to the original historic village, and a small subdivision, El Rancho Madrona, on the southwest side of the City. Most of the City is undeveloped and remains partially forested and is held by several large property owners. Weyerhaeuser Company and its subsidiary WRECO own the majority of the 3,000 acres within Northwest Landing, which is in the City of DuPont, and includes the former DuPont Works site. Other large ownerships include approximately 200 acres in two parcels north of Sequalitchew Creek that are owned by Glacier Northwest; approximately 285 acres north of Sequalitchew Creek that are within the Fort Lewis Military Reservation, and are operated by the U.S. Army as a sanitary landfill; 185 acres owned by the Intel Corporation; and 52 acres adjacent to I-5, along the southern edge of the City, that are owned by the State Farm Insurance Company.

In 1988, WRECO initiated construction of a major mixed-use development known as Northwest Landing. The development eventually will extend over approximately 3,000 acres (including the former DuPont Works site and the proposed golf course location). In 1994, WRECO completed construction of the first residential subdivision (Palisade Divisions 1 and 2) in a location adjacent to the original village area. Other components of Northwest Landing for which construction has begun include Divisions 3 through 8, and the first phase of the Yehle Park Village. In 1995, State Farm completed construction of a major regional headquarters facility on its parcel adjacent to I-5. Intel Corporation completed its first building in 1996. A small retail center opened in 1998.

The former DuPont Works site is bordered to the west by the double-tracked Burlington Northern Santa Fe Railroad mainline, which is situated near water level at the base of the bluff along Puget Sound. Sequalitchew Creek runs along the north side of the site. To the north of the creek are undeveloped industrial lands, a portion of which are being used for a sand and gravel mining operation and an associated processing plant (nearest to Puget Sound) and industrial lands for sale. Undeveloped areas within the Northwest Landing project abut the site to the east, south, and north.

Land Use and Zoning Provisions

The proposed golf course site and surrounding area is within the planning and zoning jurisdiction of the City of DuPont. The current zoning of the area (according to the City Interim Zoning Map) includes planned neighborhood (most of site) and manufacturing/research park in the northeast corner of the site generally north of Sequalitchew Creek. Provisions of the City's comprehensive planning document that apply to the proposal are summarized below. The City is currently in the process of amending the 1995 Comprehensive Plan. An updated plan is expected to be published in late 2000.

The proposed project has been reviewed for consistency with the 1995 Comprehensive Plan. Pertinent land use designations and goals prescribed in the 1995 plan are summarized on the following pages.

1995 Comprehensive Plan

The City adopted its current Comprehensive Plan on July 25, 1995. The 1995 Plan adds policies to help DuPont develop as a town with an effective pedestrian environment and to avoid a suburban pattern of excessive separation of people and land uses. Key features that the City sought to establish through the 1995 Comprehensive Plan include the following (City of DuPont, 1995):

- A recognizable and functionally diverse town center near a major thoroughfare.
- Neighborhood areas small enough to allow residents and workers to walk or ride bikes if they choose.
- A hierarchy of street sizes, and a generally regular, geometric street pattern to provide comprehensible routes of travel.
- Dwellings, shops, and workplaces generally located close to each other.
- Well-configured squares, parks, and open spaces woven into street and block patterns and dedicated to social activity, recreation, and visual enjoyment.

To achieve these objectives, the Comprehensive Plan designated a town center area surrounded by multiple villages or neighborhood areas, and used existing natural and developed features to help delineate the village locations. The northern sector of the City would continue as an area for industry. The Comprehensive Plan assumed that development of these distinct land areas would occur in sequence with the numerous designations of the respective villages (Villages I through IV, plus the already-developed Historic Village).

Village III

Parcel 1 of the former DuPont Works site includes all of the areas designated as Village III by the 1995 Comprehensive Plan, as well as most (approximately the western three-quarters) of the

Town Center area. Village III is generally bounded on the west by Puget Sound, on the north by Sequalitchew Creek, and on the east by Old Fort Lake and identified open space corridors north and south from the lake; the southern boundary of Village III is the same as the southern boundary of the Consent Decree area. The generalized land use map for the 1995 Comprehensive Plan shows most of Village III as mixed residential use; the Plan text indicates that this would be mostly single-family development, with smaller-scale multi-family housing dispersed throughout the area. Other features include a sensitive area buffer along the Puget Sound bluff; three park areas near the western edge of the village; and open space or sensitive areas long Sequalitchew Creek, between the creek and Old Fort Lake, and around the original Fort Nisqually site.

Golf Course

The 1995 Comprehensive Plan notes the remediation program for the former DuPont Works site and the concept of using golf course development as a means of implementing cleanup for the site. The Comprehensive Plan indicates that "the most contaminated soils have been removed and the remaining areas are proposed to be treated in a combination of soil washing on-site and placement under a proposed golf course" (City of DuPont, 1995). The Comprehensive Plan allocates approximately one-third of the area of Village III (nominally, 150 acres) to a golf course. This acreage estimate was based on the average size of a typical municipal golf course and was not reflective of the specific acreage that might be used in remediation and subsequent golf course development. The Comprehensive Plan does not specify where the course would be located within the village boundaries. Golf course characteristics prescribed in the Plan include the following:

- The course should provide an exciting golf experience.
- The course should provide a community benefit, which may be achieved by maintaining a significant amount of trees and natural vegetation and locating the holes such that the public can drive between some parts of the course to experience the open space.
- Public play should be allowed on the course.
- Location of housing around the course is encouraged, with a mix of lot sizes and housing types.
- Housing areas around the course should be connected by neighborhood streets, rather than being isolated by cul-de-sacs.

Town Center

The Town Center area defined in the 1995 Comprehensive Plan is bounded on the west by Village III (with the boundary along Old Fort Lake and associated open space corridors); on the north by Sequalitchew Creek; and is generally east of the Consent Decree area, although the west portion overlaps the Consent Decree area. The Town Center area is centrally located with convenient access to most of the City, and is intended to be the administrative and cultural center of the City.

Land uses allocated to the western portion of the Town Center (the portion within the Consent Decree area) include a central Town Square, civic buildings, office and commercial uses, mixed single-family and multi-family residential uses, and a large open-space buffer and park surrounding Old Fort Lake and extending down to the southern boundary of the neighborhood. None of the Town Center within the Consent Decree area was allocated to golf course use. The Comprehensive Plan indicates that there is to be public access to Old Fort Lake for passive recreation, and a community-scale park adjacent to the south side of the lake (in the same location as the park shown in the 1985 Comprehensive Plan). An open-space corridor with a trail would also connect Old Fort Lake with the Town Square to the east.

Land uses identified for the eastern portion of the Town Center (outside of the Consent Decree area) include a middle school, office use, several park areas, open space near Sequalitchew Creek and in an oak savannah area near Strickland Lake, and single-family and mixed single-and multi-family residential uses.

City-Wide

In addition to the land use designations and associated prescriptions for the Town Center and villages, the 1995 Comprehensive Plan established a number of general goals and policies that would be applied city-wide or to specific areas. The topical coverage of the goals and policies includes land use, environmental systems, open space, parks and recreation, transportation, housing, capital facilities, and utilities. The land use goals and policies are subdivided among urban form, design, street system, residential development, town center, commercial and office development, industrial development, and mineral resources aspects of land use.

3.5.2 Impacts of Alternatives 1, 2, and 3

The project site is an approximately 636-acre tract of land (Parcel 1) in the west-central portion of the City of DuPont. Approximately 30 percent of the total acreage of Parcel 1 would actually be devoted to the golf course footprint under Alternatives 1 and 3. Other uses would be developed on the remaining acreage, based on post-remediation development plans.

There are inconsistencies between the 1995 Comprehensive Plan and the proposed actions under Alternatives 1, 2 and 3. Under Alternatives 1, 2 and 3, the golf course footprint cap/containment facility (Alternatives 1 and 3) or area excavated (Alternative 2) is larger in size than the golf course area proposed in the 1995 Comprehensive Plan. In addition, part of the golf course footprint (or area excavated) would extend into the Town Center area rather than being confined to the Village III area. The golf course footprint area (or area excavated) would also displace a portion of the area proposed for Town Center use and a community-scale park, and would occupy some of the area designated for commercial use. Finally, as noted earlier in Section 2.1.3, a restrictive covenant has been filed by Weyerhaeuser with Pierce County that precludes residential use within all of Parcel 1, which includes the golf course footprint area. The restrictive covenant also precludes schools, daycares, parks, and recreational uses—except for golf courses and related amenities.

3.5.3 Impacts of Alternative 4

Alternative 4 (No Action) would not be inconsistent with the 1995 Comprehensive Plan. However, without cleanup, the soil in Parcel 1 would remain contaminated and, therefore, there will be exposure risks (human and ecological health) associated with any proposed residential, recreational or commercial uses. As a result, under MTCA, this would not be an acceptable alternative.

3.5.4 Mitigation Measures

The Mitigation Measures outlined below pertain in some degree to Alternatives 1, 2, and 3. The measures applicable only to certain alternatives are designated.

- Any future golf course developed over the cap/containment facility will need to undergo SEPA review and permitting processes that include coordination with the City of DuPont (Alternatives 1 and 3).
- The proposed cap/containment facility should be described in the updated (circa 2000) City Comprehensive Plan (Alternatives 1 and 3).
- The revised land use and associated use restrictions for Parcel 1 should be described in the updated Comprehensive Plan.
- Weyerhaeuser and the City should continue to coordinate planning for Parcel 1 as well as properties outside Parcel 1.

3.5.5 Significant Unavoidable Adverse Impacts

The proposed alternatives (Alternatives 1, 2, 3) would not result in a significant unavoidable adverse impact to land use if the mitigation measures above are implemented.